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A NATURALIST'S YEAR.

By GRANT ALLEN.

XIII.—THE BLACKCAP SINGS.

AMONG the greening red-currant trees in the garden a noisy wee bird sits perched invisibly under the shade of the lush young foliage, and sings away in changeful notes, which make it at first very hard to distinguish for what it really in the end turns out to be. When it began, it whistled gaily like a blackbird, and I thought for a moment it must be one of those light-hearted strawberry-loving thieves come to look up the chance of a ripe berry or two on the blossoming vines in the early bed. Then it struck out a plaintive note or so, like the nightingale's; and after that it glided off incontinently into the liquid treble of the thrush and the garden warbler. Presently, hopping from one bough, which it had fully cleared of the fat black and yellow banded caterpillars, to another one, as yet unweeded of its insect foes, it showed enough of its head and wings above the broad currant-leaves to disclose the fact that it was really our English mocking-bird, the lively little garden-haunting blackcap. Plain and unnoticeable as he is in plumage, there are so many odd small points of form or habit about him which cast light upon the origin and history of specific distinctions that I shall make no apology for taking him as the text of this morning's evolutionary discourse. I can watch him through the window as I write, and so make sure that I am keeping my description of his appearance and manners thoroughly true to the facts of nature.

Your blackcap is by family one of the thrush kind, and, by further restriction, he belongs to that lesser group, justly known as the warblers, distinguished (so far as outer appearance goes) from the true thrushes mainly by the fact that the young birds are unspotted on the upper part of the body. This seems, no doubt, at first sight, a very small and unimportant difference; but then we must remember that among such a closely similar class as birds generally, the specific, and even the generic and family differences are usually but slight; and, further, that resemblances between the young are almost always of high genealogical value, because they presumably represent a common ancestral form, from which the adult creatures proceed to vary in different directions. Thus, we may fairly conclude that at some early period the original thrush group split up into two minor divisions, one with spotted backs, and the other with unspotted; while in the course of time each of these minor divisions once more subdivided itself, under stress of more special selection, into the thrushes, blackbirds, and field-fares on the one hand, and the nightingales, blackcaps, and whitethroats on the other. Mr. Seebohm, one of our greatest authorities on such subjects, believes that these two main groups ought even to be ranked as separate families, and points out that the diversity indicated by the difference in the plumage of the young birds is correlated with other diversities in the mode of moulting, and in the peculiar shape of the bone known as the *tarsus*. It must be borne in mind that variations in the plumage are comparatively important as indicating specific separateness in birds, and that the only marked difference (for example) between a thrush and a blackbird is that the one is spotted and the other uniformly black. Under such circumstances, the constant presence of spots upon the back of the young blackbird, which die away with the mature plumage, must be regarded as a good hint of the original derivation of the race.

Our friend the blackcap, again, differs from the remainder of his own relations, the restricted warblers, in the possession of that little dark crest on the top of his head, from which he has acquired his popular English name. The hen birds, however, have the crest brown, instead of black—a sort of distinction which commonly occurs in similar cases. Here, in all probability, we have a very simple instance of those decorative adjuncts whose origin Mr. Darwin ascribed to the selective preferences of the female birds. In the closely-allied garden warblers the sexes are indistinguishable, but in the blackcap a distinction of some importance has been set up; and it is interesting to learn from Mr. Harting, a close observer, that the male blackcaps always arrive in England some days before the females. The natural consequence must be that the first and strongest females, when they arrive, will be able to take their choice of the heartiest and most-decorated mates, as well as the best singers. Now, it so happens that among the garden warblers, too, the cock birds are the first to come; and an objector might easily ask why they also are not similarly decorated. That is just the sort of objection which it is always easy to raise against evolutionary reasoning, and the answer to which is very simple. Everything must have a beginning. However much decorated any class may now be, there must have been a time when it first began to acquire its earliest ornaments. Thus the garden warblers may, perhaps, even now be starting on the road toward the acquisition of a distinctive male topknot. But, on the other hand, selection of this sort must be constantly subordinated to natural selection of the strongest or the best-protected individuals. Thus, it may also happen that among the very civilised garden warblers, any extra decoration might be harmful rather than useful. In short, it is always relatively easy to account for what is—easy to show why Englishmen with firearms get the better of Red Indians with bows and arrows; it is not always so easy to account for what is not—to explain why Red Indians did not invent gunpowder before the English. I may add that the little white-throats also come to our shores before the ladies of their kind, and skulk about in the hedges till the hens arrive; but as soon as this happens, they take their stand conspicuously on the topmost branches by the wayside, and sing emulously against one another for the attraction of their listening mates. To my mind, these incipient

stages in the selective process are quite as essential to Darwin's argument as the highly-evolved display of the peacock, the turkey gobbler, and the Argus pheasant. The one set of examples shows us the mechanism actually at work; the other set shows us the developed result.

The blackcap comes over to us about the middle of April, and continues in full song till the end of June. Being a conspicuous and brisk little bird—far more likely to invite a stray stone from the murderous hand of ingenuous youth than the dull-hued sparrow, or even the nimble chaffinch—it hides its black-topped head for the most part under the shade of thickets; but it is very fond of gardens, where not too exposed, as it is a confirmed fruit-eater, given to making great depredations among the raspberries and currants. It is a noteworthy fact, however, that the young blackcaps will eat nothing but insects; it is not till they have attained to years of discretion that they take to their final habit of plundering fruit-bushes. This trait, common to many, if not to most, fruit-eaters, may be put side by side with the one noted by Mr. A. R. Wallace, that the young humming-birds, which are developed flower-haunting swifts, will eat nothing but spiders and small flies. In both cases, the facts point back curiously to the original habits of the whole race. There can be very little doubt that all birds were at first carnivorous, piscivorous, or insectivorous, and the greater part of them probably remain so to the present day. The practice of eating grains and seeds came later; while that of living upon fruits, or the nectar of flowers, must have been the latest of all. Indeed, the development of succulent fruits or berries seems to me to be a very recent acquisition on the part of plants generally; and it must have proceeded side by side with the evolution of fruit-eating habits in the correlated birds. Hence we find the young still require to be fed upon animal food; and, indeed, the adult blackcaps, like many other similar mainly frugivorous species, cannot get along for any length of time without a liberal admixture of slugs and caterpillars in their food. On the other hand, the most advanced fruit-eaters, such as the parrots, readily revert to carnivorous practices in confinement; and one New Zealand species, since the introduction of sheep into the colony, has become a perfect pest to the breeders by its partiality for animal dainties.

At the same time, adult blackcaps have now got so thoroughly accustomed to their vegetable food that they will not live in captivity without fresh fruits in summer, and a little pear or apple in winter. Being such sweet and varied singers, they are often kept as "pets" by people who "are fond of birds," much as one might keep a great pianist in prison, by way of admiring his musical genius. In their wild state, blackcaps love freedom and retirement; so that the confinement and publicity of a cage must be perfect misery to such pert and agile, but timid, birds. They sing best in the month of May, when food is most abundant, and when the nesting is going on. Both birds take turn about in hatching the clouded, pale brown eggs, one feeding while the other sits; but they don't like to be interfered with during the nesting period, and will desert their eggs if any attempt is made to intrude upon their privacy. All these little psychological points have their own peculiar value in the economy of the race; and the more one studies birds, the more does one begin to see that their dispositions are all as strictly correlated as is outward structure to the general necessities of the species. Blackcaps are above everything timid hangers-on of civilisation; and their habits are accommodated to the needs of their situation. They cannot live readily in very wild countries, and it is a matter of observation that they have grown more and more numerous in Scotland with the spread of cultivation in the north, whither they have closely followed the currants and other garden fruits. Indeed, the extent to which mankind has modified and altered the European fauna and flora opens up a question still, I believe, only very partially understood. There seems to be good reason for thinking that a very large number of existing species can only have assumed their present forms since the date when tillage first became common in the western Asian and Mediterranean regions.

LAWS OF BRIGHTNESS.*

By Richard A. Proctor.

THERE are few subjects on which illusions are so widely prevalent as that of brightness, whether the brightness of self-luminous objects, or that of opaque bodies under illumination. For example, nearly every one who has not given the subject close attention supposes that a luminous body, of either kind, shines with a seemingly fainter light when at a distance than when near at hand, independently of any absorptive effects exerted by the medium through which the object is seen. Again, it is quite a common error that a luminous surface, when looked at slantwise, appears less luminous than when looked at directly. When the effects of telescopic appliances are in question, mistakes of a yet more widespread nature are met with. Thus, quite a large proportion, even of those who are in the habit of using telescopes, entertain the idea that by means of a telescope an object may be made to appear brighter. The notion that the moon, for instance, shines no more brightly as seen with a large telescope than as seen with the naked eye is at a first view scouted as ridiculous by many telescopists. Again, those accustomed to the use of night-glasses are usually prepared to asseverate that objects seen through such glasses are rendered considerably brighter; otherwise, indeed, they argue a night-glass would be of no use whatever.

I propose here to consider a few of the leading facts connected with the subject of brightness. They are of extreme importance in many branches of research, and a knowledge of them would prevent observers, as well as theorists, from falling into many errors, either as to methods, or as to the interpretation of observation.

First, as to self-luminous objects.

The first point to be noticed of self-luminous surfaces is that they shine with equal brightness in whatever direction they may be viewed. If a red-hot poker be looked at in a dark room it will be seen that the faces of the heated square-sectioned part are of equal apparent brightness. The experiment may equally well be tried in a lighted room; only, care must be taken that the poker itself is not placed in a strong light, for then, since a portion of its brightness is reflected, there will be a certain degree of apparent shading, the same in kind though not in degree, as though the poker were an opaque body. A red-hot globe of iron may be usefully studied in different lights, and especially in full sunlight, when the apparent shading of the ball is strikingly contrasted with the dead uniformity of the disc presented when the ball is viewed in a dark room.

The law here stated is strictly an experimental one. There is nothing in the nature of things which should lead us to expect this law. The law requires that the light

* These papers, which are reprinted with little alteration from the *English Mechanic*, in which they appeared several years since, are introductory to a series of papers on "Spectroscopic Analysis," which will be commenced in Vol. V.

waves emitted from a self-luminous surface should diminish in intensity as the sine of the angle between them and the surface. For let A B, A′ B′, be two spaces on the self-luminous surface, represented at two positions at S *s* and S′ *s*′, viewed by the eye at E and E′ respectively, and *appearing* as so seen to be equally large circles, the real circle, A B, being viewed squarely, the oval, A′ B′, being viewed obliquely. Then, obviously, A′ B′ is larger than A B in the same proportion that A′ B′ exceeds *a*′ B′. Hence, if

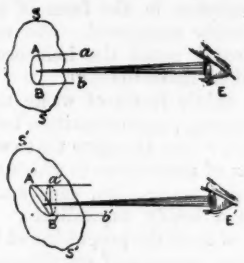

Fig. 1.

waves proceeded as freely from every point in A′ B′ towards E′ as from every point in A B towards E (a pencil from a point in each space is shown in the figure), the eye, E′, would receive more light from the space A′ B′ than the eye E receives from the space A B; and as the two spaces *appear* equally large to these respective eyes, the space A′ B′ from which most light came would appear the brightest, in the same proportion that it exceeds the space A B. But as it only appears equally bright, the light waves proceeding from each point of it towards E′ must be smaller than those from each point of A B towards E in the proportion that the space A B is less than the space A′ B′; that is, in the ratio B′ *a*′ to B′ A′. But $\frac{B'}{B'}\frac{a'}{A'}$ is the sine of the angle B′ A′ *a*′, which may be taken as the average angle which the course of light from the space A′ B′ to E makes with the plane S′ *s*′.

The second point to be noticed in self-luminous surfaces is that they appear equally bright at all distances, unless seen through an absorptive medium. This law may be demonstrated experimentally; but in reality it may be regarded as resulting directly from the nature of light.

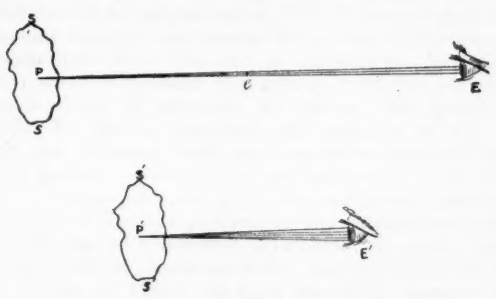

Fig. 2.

Thus, let E and E′ (Fig. 2) be two eyes at different distances, viewing the same self-luminous surface represented at S *s* and S′ *s*′. Then, obviously, the light pencil from any point P in S *s* to the more distant eye E is smaller than the light pencil from a point P′ in S′ *s*′ to the nearer eye E′ in the proportion that the square of P′ E′ is less than the square of P E. For the cross-section of the former pencil at *e*, such that P *e* is equal to P′ E′, is less than the cross-section at E (the pupil of the eye), that is, than the cross-section of the pencil P′ E′ at E′, as the square of P *e* is less than the square of P E. In other words, the cross-sections of the two pencils, at equal distances from the luminous surface, are inversely as the squares of the distances from which the eye views the surface. But it is equally obvious that the apparent size of the surface is reduced in precisely the same degree with distance. Thus, the total quantity of light received from the surface is reduced with increase of distance, in precisely the same ratio that the apparent area of the surface is reduced. But this amounts to saying that the surface appears equally bright at all distances. However, the matter can be readily demonstrated by experiment. Thus, if two globes of iron of unequal size be heated to the same degree of redness, and if they be then placed in a dark room at such distances from the eye as to appear equally large, it will be found that they appear absolutely alike in all respects. Again, if two candles of the same kind be placed at unequal distances in clear air, it will be seen that the flames, though they seem unequal in size, remain apparently equal in intrinsic luminosity.

Next as to opaque bodies shining by reflected light.

First, both the laws just stated for self-luminous bodies hold also for illuminated opaque bodies. The second law admits of being tested more thoroughly in the case of illuminated than in that of self-luminous bodies. Thus, from observations of the planets, it has been found that the quantity of light received from the same planet at different distances, but in other respects similarly situated (as from Mars when in opposition near perihelion and near aphelion), varies inversely as the square of the distance, which is, of course, precisely the ratio in which the apparent dimensions of the disc vary.

The two laws may be combined into one simple and easily-remembered statement:—*A surface, whether self-luminous or illuminated, appears in all positions and all distances just as bright as it is in reality.* Of course, this law does not take into account the absorption exercised by any medium through which a luminous object may be viewed.

(*To be continued.*)

ZINC COATING FOR IRON.—Attention has recently again been drawn to MM. Neugean and Delaite's process of protecting iron surfaces against rust. A very fine powder of metallic zinc is mixed with oil and a siccative, and applied to the iron by means of an ordinary brush. In many cases one coat is sufficient; two coats are at any rate guaranteed to secure a protection against the corrosive action of the atmosphere as well as of sea water. The zinc coating gives the iron a steel-grey appearance, and it does not interfere with subsequent painting. MM. Neugean and Delaite received a diploma at the Paris Electric Exhibition of 1881, and now recommend their process for iron structures, bridges, lamp-posts, &c., and also for iron ships. If this process really affords the protection it claims, nothing need be said in recommendation of it, since it can hardly be surpassed in simplicity and cheapness, and is capable of application in cases where galvanising, the Bower-Barff, and similar processes would hardly be practicable. A good mixture, of which only the necessary quantity ought to be prepared, consists of 8 parts by weight of zinc, 71 of oil, and 2 of a siccative.—*Engineering.*

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XUM

"OUR BODIES:"

SHORT PAPERS ON PHYSIOLOGY.

By Dr. Andrew Wilson, F.R.S.E., &c.

No. XII.—THE BODY'S INCOME AND EXPENDITURE.

In the course of our previous studies we have seen that the work of the body is perpetually associated with waste. Work and waste bear, in fact, a very well defined relation to each other; and of necessity, the function of nourishment, whereby repair of this waste is effected, must in turn relate itself to both processes. Work is impossible without the energy (or power of performing it) we derive from our food, and the bodily waste is merely one indication of the extent to which that energy has been applied in carrying out the acts of life. A human body, as the result of its work, then, is perpetually breaking down, in a chemical sense, into various waste products. Of these products so much *heat* may be regarded as waste matter, seeing that it is given off from the body, and is thus lost to it. *Water* forms a second product of extreme importance, as also does, thirdly, the gas named *carbonic acid*. A fourth kind of waste is represented by the substance known as *urea;* and, fifthly, we can detect *ammonia* amongst the waste materials of our frames. To these we may add *organic matters* of various kinds, consisting of the actual worn-out cells and particles of the body; and *minerals*, whereof a considerable quantity is excreted or given off by the skin and kidneys especially.

The work of excreting or removing these waste matters from the blood, into which they have been poured as the result of the tissue-waste, falls chiefly upon the *lungs*, *skin*, and *kidneys*. These organs form, in fact, a kind of physiological trio, engaged in the same kind of work, and capable of mutually aiding each other in its performance. The same products are excreted by all three organs, but in different proportions. The practical benefit of this knowledge is seen in the treatment of many diseases. For when the lungs are disordered in any way, the physician can compel the skin and kidneys to take up so much of the lung's work, by giving medicines which stimulate the skin and kidneys respectively. When the kidneys similarly suffer disorder, skin and lungs come to their assistance. The mere fact that skin and lungs co-operate to perfectly and invariably during exercise is sufficient to impress upon us the close interdependence which exists between these organs.

When we endeavour to sum up the income and expenditure of the body in a kind of physiological balance-sheet, we are met by the consideration that whilst the work of repair, or the facts of bodily income, are plainly enough to be discerned, the sources of loss or expenditure are not so readily noted. We know that *food*—solid and liquid—is converted into our own substance, and that the *oxygen* of the air also forms part of our dietary, since it is necessary for the maintenance of heat, and for other vital purposes. But the sources of loss are not so apparent as the means and ways of gain; hence we must firstly see where and how the bodily income is spent. A little consideration will show us that there must be a considerable amount of loss incurred through the action of what may be called the ordinary "wear and tear" of life. All the organs and tissues must wear and lose their substance in the discharge of their duties. In such an organ as the stomach, daily engaged in the important work of digestion, or the liver, which is perpetually engaged in its labour of manufacturing bile, there must be constant loss of substance. Again, there is actual waste of muscular substance in every movement of life, from the winking of an eyelid, or the stroke of the heart, to the blacksmith's energetic labours, hammer on anvil. Much of the bodily waste (water, heat, carbonic acid, etc.,) must therefore arise from this source. A second source of waste is that incurred in the production of heat and of movement in our bodies. We are perpetually losing and giving off heat, yet the normal temperature of our bodies (about 100° Fahr.) requires to be maintained. Such an amount of heat cannot be generated without expenditure of force, or without the presence of *ash*, so to speak, which *ash* makes its appearance in the form of certain of the waste products already mentioned. As regards bodily *motion*, we have already noted the immense expenditure which muscular action entails upon us.

Other and more subtle forms of waste make demands upon our stores of energy, and necessitate bodily wear and tear as an equivalent. The thoughts that originate in the brain, the expression of nerve-force to which they give rise, its conveyance by the nerves, are, each and all, so many sources of waste and bodily expenditure. Even *growth* itself, the digestion of food, the propulsion of blood through the body, and all other processes of nourishment, necessitate an outlay of the store of strength we possess. It is thus perfectly true, in one sense, that life is a process in which we burn the candle at both ends. The very acts whereby we build up our frames anew, and nourish our bodies, whilst repairing these frames, at the same time draw from them the strength and energy we owe to previous acts of nourishment.

Summing up the sources of *income* of our bodies, we may discover, firstly, that in *solid food*, *water*, and *oxygen* we may be said to place our physiological trust. An adult consumes every day about 8,000 grains of solids, about 35,000 grains weight of water, and about 13,000 grains weight of oxygen. Nearly 8½ lb. of matter, calculating roughly, represent the daily income. Daily expenditure practically shows a similar amount, for supposing growth has ceased, then income and loss will, in health, be as nearly as may be adjusted; and if our means of research were more delicate, they would probably be found, in health, exactly to correspond. From the lungs we give off, per day, carbonic acid gas, water, and organic matters equal to 20,000 grains. The skin gets rid, in the same time, of nearly 12,000 grains weight of water, minerals, gases, etc. The kidneys excrete about 24,000 grains of waste (water, urea, minerals, etc.), and from the intestine the digestive waste given off may be estimated at about 2,800 grains weight. It follows that with about 8½ lbs. of material income, and the same amount of material expenditure, a man will deal with about 3,000 lbs. weight of matter per annum; and we cannot regard the amount as excessive, if we consider, even for a moment, the immense amount of work which his body performs upon that material, and the results of its conversion into bodily power. It has been calculated, indeed, that the daily force expended by an adult in maintaining his temperature, or heat, in the work of heart, lungs, &c., and in his muscular acts, may be set down at 3,400 foot-tons. In other words, the daily life of man, summed up in one huge lift, would be capable of raising 3,400 tons one foot high.

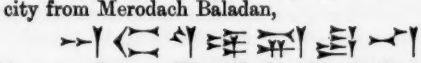
An American paper gives the following:—The United States burns about 322,000,000 dols. worth of wood every year. Railroads burn over 5,000,000 dols. worth. Brick and tile factories burn 4,000,000 dols. Mining operations consume, as fuel, 3,500,000 dols. worth. Steamboats burn about 2,000,000 dols. worth.

THE LIBRARIES OF BABYLONIA AND ASSYRIA.

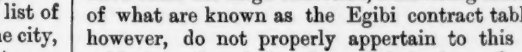
III.

AMONG Babylonian library cities, Babylon itself of necessity occupies a prominent position, and to give an adequate account even of the various subjects upon which its cuneiform inscriptions are written, ranging, as they do, from a calculation of interest on a loan of a few shekels to an official description of the conquest of a mighty empire, would occupy more space than is available. A visit to the Tablet Gallery of the British Museum will give some slight idea of the riches that its mounds, or those of the suburb of Borsippa (Birs. Nimroud), have already yielded up. Babylon is remarkable from our present point of view for the great length of time over which the dates of its relics are scattered, texts having been found there of the highest antiquity, such as that of Ru Sak, written only in Accadian, and others gradually ranging down to an astrological tablet of the time of Arsaces. Among the oldest may be mentioned a list of the names of the months in Assyrian and Accadian. A tablet, called the Prayers of Amil Urgal, a calendar of lucky and unlucky days, a list of stones, also a fragment containing part of a map of the city, and others with geometrical figures. Among more recent ones, the famous cylinder of Cyrus, which decides for ever the truth of his genealogical table as given by Herodotus; and the (so-called) cylinder of Nabonidus referring to the fall of Babylon. Later still are numerous tablets of the successors of Alexander, Seleucus, Demetrius, and Antiochus, some of them, especially an inscription of the latter prince, proving that they restored and beautified the temples of E-Saggil and Ezida with apparently as much piety as the earlier native kings. The inscriptions on Ptolemaic temples, notably at Edfou, and the interesting researches of M. Revillout in the demotic papyri, show how thoroughly the Lagides identified their faith with, and adopted the dogmas and ritual of, the Egyptian religion, and from this text it appears the same policy of conciliation was adapted by the Greek rulers of Mesopotamia.* One of the most interesting chapters of history yet remaining to be written is that which will enable us correctly to understand and appreciate the means by which a mere handful of Greeks, after the loss of their great leader and notwithstanding insane strifes with each other, successfully ruled for so long a period over millions of people, including descendants of the greatest empires of antiquity, from the Sutledge to the Nile, and not a little of the explanation will be found in their wise compliance with the religious culture of their subjects.† Mr. George Smith found at Babylon the remains of a library attached to the temple of Bel, consisting chiefly of instructions as to the ritual and ceremony to be observed in his worship, and gives translations in his "Assyrian Discoveries."

Some curious relics originating from Babylon were found by M. Place at Nineveh, and appear to have been carried off by Sargon, King of Assyria, when he conquered the city from Merodach Baladan,



to his new palace at Khorsabad. Among these are some oval shaped objects, termed olives by M. Oppert, pierced like beads, perhaps to suspend around the neck. They are usually inscribed with the name of a woman and that of a master or husband, with a date, probably that of purchase in the case of a slave. M. Oppert, who has translated several of these, however, thinks they come from a temple, and refer to the licentious worship of Mylytta, described by Herodotus. They may, however, have belonged to Babylonian women carried away captive to Assyria, and hence are found among the ruins of one of her cities. One in the British Museum runs as follows: "Of the female Hipa, slave of Sinesses, month Sebet, eleventh year of Maruduk-bal-iddina King of Babilu." Another Babylonian relic found at Nineveh, is the cone of an ancient Babylonian Monarch, read by Mr. Smith, ·Vul-bal-idinav; by Oppert, Ben habal iddina, but is now decided to be Rimmon bal idiuav



In one sense Babylon has, with the recent exception of Sippara, been the most generous in the literature it has preserved for our time, for from the Jumjuma mound there have come the large collection, numbering more than 3,000, of what are known as the Egibi contract tablets. These, however, do not properly appertain to this part of our subject, as though found on Babylonian soil; they do not belong to the age of her first civilisation, but to the much later times of Nebuchadnezzar, Nabonidus, and Cyrus and his successors. They will be described fully in treating of contract tablets as a class.

* The new cylinder of Cyrus appears to indicate a similar compliance with Babylonian beliefs on his part, just as does the hieroglyphic inscription of the "Pastophorus of the Vatican" show us Cambyses being initiated into and upholding Egyptian religion.

† *See* Robiou "L'Economie Politique, l'Administration, et la Législation de l'Egypte au Temps des Lagides," and Lombroso "L'Economie Politique de l'Egypte sous les Lagides," and Droysen "Geschichte des Hellanismus."

ELECTRIC LIGHTING AT CHESTERFIELD.—The Committee of the Chesterfield Town Council, appointed to consider the electric lighting arrangements in the town, which have now been in existence for some time past, have reported that the lighting of the streets has been completed to their satisfaction. In accordance with this report the Town Council have decided to enter into a permanent contract with the Hammond Electric Light Company, by whom the work has been carried out.

OIL TANKS FIRED BY LIGHTNING.—The following telegram appeared in the *Standard* of Friday, the 11th inst. It was dated New York, Thursday night (May 10), and stated that "During a storm to-day (Thursday) the lightning struck and set fire to a wood factory in the midst of a dense tenement-house population adjoining the Belle Vue Hospital in Jersey City. For a short time the excitement was intense, but the amount of damage was small. Another flash did more damage. It struck the Standard Oil Company's works in Jersey City, and a huge iron tank exploded with a violence which shook the earth for a long distance. The flame which immediately rose was seen twenty-four miles off. Ponderous fragments of the tank were thrown a distance of half a mile, and the crowds who assembled on the top of a neighbouring hill a mile away were scorched. The blazing fluid poured in a great stream towards the river, and on its way ignited other tanks. The workmen and firemen ordered to retreat before this sudden foe started upon a fearful race; their hair and clothing were singed, and the six who were most in the rear were overwhelmed. It is feared that other fatalities have occurred. The destruction has involved eighteen tanks of crude oil and two of naphtha, each averaging, perhaps, ten thousand barrels. The works, which covered twenty acres, also contained many thousand barrels of refined oil. The loss is variously estimated at sums all of which approach one million dollars."

THE CHEMISTRY OF COOKERY.

IX.

By W. Mattieu Williams.

As stated in my last, the subject of roasting occupied a large amount of Count Rumford's attention, especially while he was in England residing in Brompton-road, and founding the Royal Institution. His efforts were directed not merely to cooking the meat effectively, but to doing so economically. Like all others who have contemplated thoughtfully the habits of Englishmen, he was shocked at the barbaric waste of fuel that everywhere prevailed in this country, even to a greater extent then than now.

The first fact that necessarily presented itself to his mind was the great amount of heat that is wasted, when an ordinary joint of meat is suspended in front of an ordinary coal fire to intercept and utilise only a small fraction of its total radiation.

As far as I am aware, there is no other country in Europe where such a process is indigenous. I say "indigenous" because there certainly are hotels where this or any other English extravagance is perpetrated to please Englishmen who choose to pay for it. What is usually called roast meat in countries not inhabited by English-speaking people, is what we should call "baked meat," the very name of which sets all the gastronomic bristles of an orthodox Englishman in a position of perpendicularity.

I have a theory of my own respecting the origin of this prejudice. Within the recollection of many still living, the great middle class of Englishmen lived in town; their sitting-rooms were back parlours behind their shops, or factories, or warehouses, their drawing-rooms were on the first-floor, and kitchens in the basement.

They kept one general servant of the "Marchioness" type. The corresponding class now live in suburban villas, keep cook, housemaid, and parlour-maid, besides the gardener and his boy, and they dine at supper-time.

In the days of the one marchioness and the basement kitchen, these citizens "of credit and renown" dined at dinner-time, and were in the habit of placing a three-legged open iron triangle in a brown earthenware dish; then spreading a stratum of peeled potatoes on said dish, and a joint of meat above, on the open triangular support. The combination was carried by the marchioness to the bakehouse round the corner at about 11 a.m., and brought back steaming and savoury at 1 p.m.

This was not done always, but at other times, as when the condition of the mistress's wardrobe offered no particular motive for going to church, she stayed at home and roasted the Sunday dinner. The experience thus obtained demonstrated a material difference between the flavour of the roasted and the baked meat very decidedly in favour of the home roasted. Why?

The principal reason was, I believe, that the baker's large bread-oven contained at dinner-time a curious medley of meats—mutton, beef, pork, geese, veal, &c., including stuffing with sage and onions, besides the possibility of a joint or two that had been hung longer than was necessary for procuring tenderness. The vapours of these would induce a confusion of flavours in the milder meats, fully accounting a for the observed superiority of the home-roasted joints.

A little reflection on the principles already expounded will show that, theoretically regarded, a given piece of meat would be better roasted in a closed chamber radiating heat *from all sides* towards the meat than it could be when suspended in front of a fire and heated only on one side, while the other side was turned away to cool more or less, according to the rate of rotation.

If I agreed with the popular belief in the advantage of open-air exposure to direct radiation from glowing coal, I should suggest that for large joints a special roasting fire be constructed, by building an upright cylinder of fire-brick, and erecting within this a smaller cylinder or grating of iron bars, so that the fuel should be placed between these, and thus form an upright cylindrical ring or shirt of fire, inclosed outside by the bricks, but open and glowing towards the inside of the hollow cylinder, in the midst of which the meat should be suspended to receive the radiation from all sides.

The whole apparatus might stand under a dome, terminating in an ordinary chimney, like a glass-house or a steel-maker's cementing furnace; or, in this respect, like those wondrous kitchens of the old seraglio, to which I have already alluded, where each apartment is a huge chimney, outspreading downwards, so that the cooks and their materials and apparatus, as well as the huge fires themselves, are all under the great central chimney shaft.

I do not, however, recommend such an apparatus, even to the most wealthy and luxurious epicure, because I am convinced, not merely from theoretical considerations, but also from practical experiments, that all kinds of meat may be not merely as well roasted in a close oven as before an open fire, but that the close chamber, properly managed, produces *better results in every respect* than can possibly be obtained by roasting in the open air.

To obtain such results there must be no compromise, no concession to any false theory respecting a necessity for ventilation.

Many modern kitchen ranges are fitted with such compromises in the shape of a ventilated roasting oven, the action of which ventilation is purely and simply mischievous, excepting in the case of semi-putrid game or venison, which require to be carbonised and disinfected as well as cooked, and, of course, also demand the speedy removal of their noxious vapours.

Not so with fresh meats. There is nothing in the vapour of beef that can injure the flavour of beef, nor in the vapour of mutton that is damaging to mutton, and so on with the rest. But there is much that can, and does, actually improve them; or, more strictly speaking, prevents the deterioration to which they are liable when roasted before an open fire. I will endeavour to explain this.

Carefully-conducted experiments have demonstrated the general law that atmospheric air is a vacuum to the vapour of water and other similar vapours, while each particular vapour is a plenum to itself, though not to other vapours; or, otherwise stated, if a given space, at a given temperature, be filled with air, the quantity of aqueous vapour that it is capable of holding is the same as though this space contained no air at all, nor anything else. But this same space may contain a much smaller quantity of aqueous vapour, and yet be absolutely impenetrable to aqueous vapour, provided its temperature is unaltered.

Thus, if a bell-glass, filled with air under ordinary pressure, at the temperature of 100° Fahr., be placed over a dish of water at same temperature, a quantity of vapour, equal to 1-30th (in round numbers) of the weight of the air, will rise into the bell-glass, and there remain diffused throughout. If there were less air, or no air at all (temperature remaining the same), the bell-glass would obtain and hold the same quantity of vapour.

If, instead of being filled with air, it contained at the outset only this 1-30th of aqueous vapour, it would now be an impenetrable plenum, behaving like a solid to aqueous

vapour—no more can be forced into it without raising its temperature.

But while thus charged with aqueous vapour, there would still be room for vapour of alcohol, or turpentine, or ether, or chloroform, &c. It would be a vacuum to these, though a plenum to itself. On the other hand, if the alcohol, turpentine, ether, or chloroform were allowed to evaporate into the bell-glass, a certain quantity of either of these vapours would presently enter it, and then this vapour would act like a solid mass in resisting the entry of any more of its own kind, while it would be freely pervious to the vapour of water or that of the other liquids.

A practical example will further illustrate this. Some years ago I was engaged in the distillation of paraffin oil, and had a few thousand gallons of the crude liquid in a still with a tall head and a rising condenser. In spite of severe firing, the distillation proceeded very slowly. Then I threw into the still, just above the surface of the oil, a jet of steam. The rate of distillation immediately increased with the same firing, although the steam was of much lower temperature than the boiling oil, and, therefore, wasted much heat. The *rationale* of this was that at first an atmosphere of oil vapour stood over the oil, and this was impervious to more oil vapour, but on sweeping this out and replacing it by steam, the atmosphere above the liquid oil was permeable by oil vapour. This principle is largely applied in similar distillations.

But I am exceeding my limits, and must, therefore, defer the direct application of these principles to my next, though, doubtless, most of my readers will anticipate, or in vulgar but expressive phrase, "see what I am driving at."

IN a paper in the *Comptes Rendus*, "On the Liquefaction of Nitrogen," by MM. Wroblewski and Olszewski, it is stated that nitrogen cooled in a glass tube to — 136° C., and under a pressure of 150 atm., does not liquefy. On sudden release there is tumultuous ebullition. Gradual release, not passing 50 atm., yields the liquid, clear and colourless, with a distinct meniscus; it evaporates very quickly. The liquefaction of CO under like conditions on April 21st was announced.

LAKE WINNIPEG.—Recent exploration and levelling shows that the surmise of General G. K. Warren to the effect that Lake Winnipeg once discharged itself into the Mississippi on the south, instead of Hudson's Bay on the east, is correct. Mr. J. D. Dana, the well-known geologist, in a paper in the *American Journal of Science*, fully discusses the evidence, and shows that the change was due, not to a barrier of ice or earth, but to a change of level over a wide area. The geological facts he adduces point to the following succession of events: The lake deposits, being underlaid by unstratified drift, show that before the great lake existed, a glacier had moved southward over that region, and deposited moranic material. The high level prairie on either side of the lake region and of the Minnesota Valley is made up of this unstratified drift; but the generally level surface in the part next the lake valley and the stratification in the material show that the floods from the melting ice levelled it. This period of floods was followed by the era of the great lake, that is to say, of quiet waters and gentle deposits, with a slow discharge over the Lake Traverse region, which appears to have been brought about by a diminution in the slope of the general surface, which was part of a great change of slope which went on, as General Warren has explained, until the land was reduced to its present inclination and the stream to its present courses.

BALDNESS.

IN an article recently contributed to the *Gesundheit*—a paper, as its name imports, devoted to sanitary subjects—Professor Reclam, a German *Gelehrter*, makes some timely and useful observations on the subject of baldness. After describing, in a vein of pleasantry, the vast array of bare polls which may be seen any evening in the pit of a theatre or the body of a lecture-room, he discusses the causes of baldness. He does not think, as is sometimes said, that loss of hair is the result either of impaired health or of much study. The strongest men are often bareheaded, and German professors, who are nothing if not studious, are distinguished above all men by the profusion of their locks. On the other hand, soldiers and postilions, who wear heavy helmets and leather caps, and wear them a good deal, are frequently as bald as billiard-balls. From these facts Herr Reclam draws the conclusion that baldness comes chiefly of the artificial determination of blood to the head, and to the heat and perspiration thence arising. The result is a relaxed condition of the scalp and loss of hair. If the skin of the head be kept in a healthy state, contends the Professor, the hair will not fall off. To keep it healthy, the head-covering should be light and porous, the head kept clean by washings with water, and the hair cut short. The nostrums vended as hair restorers, and on which a fabulous amount of money is wasted by the ignorant for the benefit of quacks, he denounced as worse than useless. In ninety-nine cases out of a hundred they are worse than useless. Cleanliness and cold water are the sole trustworthy specifics; but when once the hair roots are destroyed, not all the oil of Macassar, the bear's grease of Siberia, nor the cantharides of Spain will woo back the vanished locks.

THE census of 1880 shows that the unsettled area of the United States amounted to 1,400,000 square miles, being nearly one-half the entire area of the country. The unsettled area east of the Appalachian range of mountains has been reduced to 10,000 square miles only, and in the original thirteen states there are less than 15,000 square miles unoccupied. Wisconsin and Michigan show 20,500 square miles as still unsettled, while Texas has no less than 137,000 square miles of vacant land. In the territory west of the Mississippi, including Minnesota, Dakota, Kansas, Nebraska, Iowa, Missouri, Arkansas, New Mexico, Arizona, Colorado, Montano, Idaho, and the Pacific States, 1,200,000 square miles are either unoccupied or inhabited only by Indians. There is thus room for an enormous increase of population.

A CORRESPONDENCE is proceeding in the *Giornal dei Lavori Pubblici* (Rome, May 9) on the question of constructing a steel bridge over the Strait of Messina. Engineer Giambastiani has presented to the Minister of Public Works a plan for the colossal bridge, to be built in five spans, three of which would measure one kilomètre (·621 of a mile) each. This design has been favourably received by Signor Baccarini. Engineer A. Cokran (of the *Impresa Industriale*) now writes to point out that he had himself prepared a plan for such an enterprise as far back as the year 1866, and that it is perfectly practicable, if the cost can be met. The question of foundations presents the chief difficulty, on account of the great depth of the Straits (about 196 ft. being the minimum), and this he suggests meeting by founding the piers of the bridge upon submerged pontoons, anchored at a depth of about 35 ft. below the surface. He appears to doubt, however, whether the enormous cost of the undertaking would be worth incurring.

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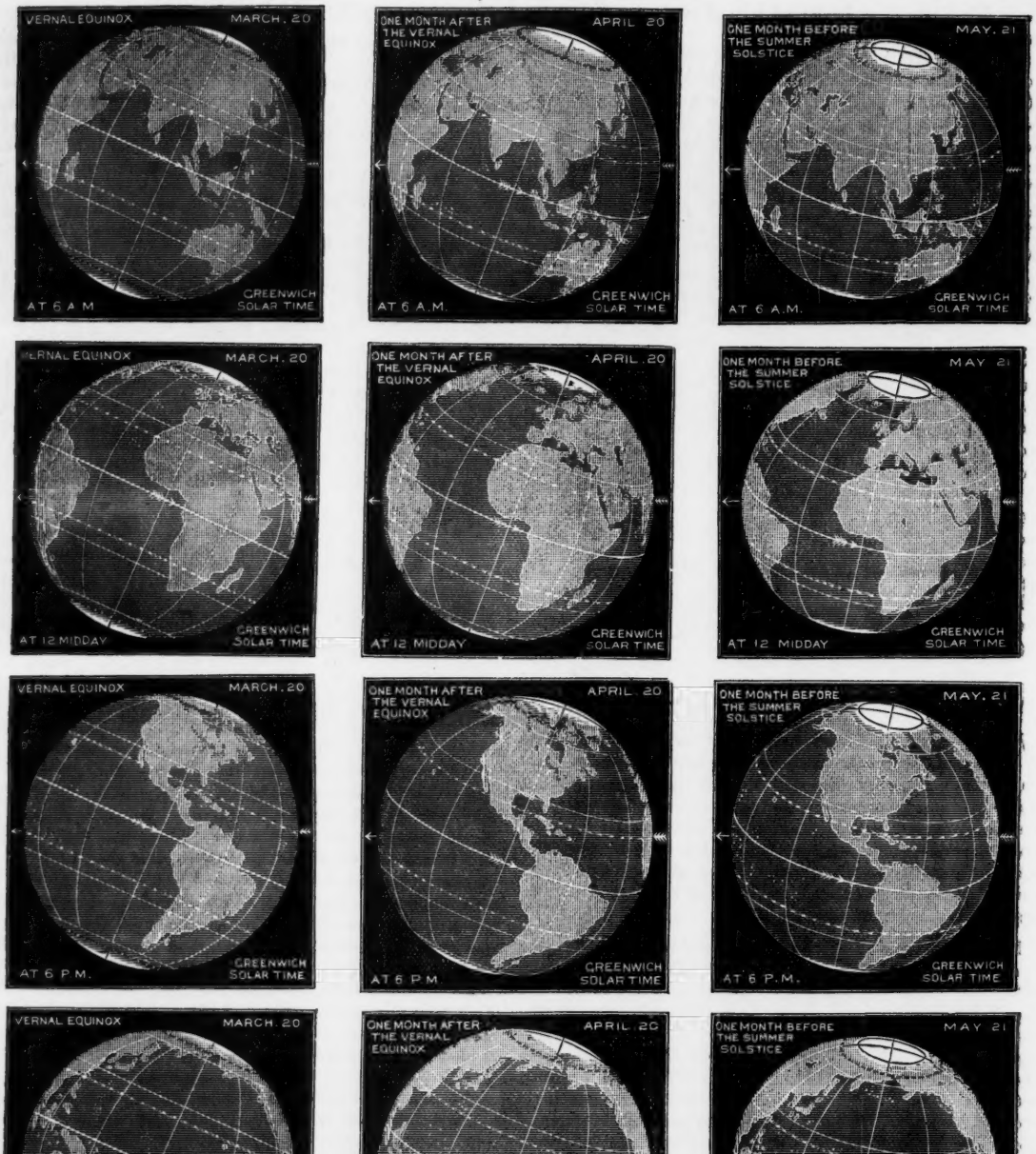

SUN VIEWS OF THE EARTH;

OR, "THE SEASONS ILLUSTRATED."

By Richard A. Proctor.

WE give this week our monthly views of the earth's face, as seen from the sun at 6 in the morning, noon, 6 in the evening, and midnight, Greenwich time (solar); with the corresponding aspects for the two preceding months for comparison.

Reviews.

GEOLOGY AFIELD.*

THE second edition of this most useful and interesting work has been sent to us for review; and though it is not among the publications of the year, we gladly call the attention of our readers to a book from which the young geologist can gain more than from many volumes of mere geological lore, however valuable. For this work shows him how to set about observing for himself, how to trace strata, lay down their boundaries, work out their dip, ascertain the character, peculiarities, and geological age of the rocks, and how to discover, determine, and classify the rocks which they contain. The directions for these purposes are simple and clear.

Yet it is not to be inferred that the book is without value for those who have not time for actual geological exploration. On the contrary, we know of no work on geology which is better calculated to give the mere student of the subject clear conceptions of the value and significance of actual geological work and observation. He can accompany the worker in imagination, though unable to take hammer, pick, and spud, for the work of survey.

The section on palæontology is well written, and full of interest. Those who imagine that palæontology has no practical value, and picture the palæontologist as a mere collector of old fossils, will do well to note how thoroughly unpractical are those who neglect the teachings of this department of geological inquiry. "I have known," says the late Mr. J. B. Jukes, "even in the rich coal district of South Staffordshire, shafts continued down below the coal measures, deep into the Silurian shales, with crowds of fossils brought up in every bucket, and the sinker still expecting to find coal in beds below those Silurian fossils. I have known deep and expensive shafts sunk in beds too far above the coal measures for their ever being reached, and similar expensive shafts sunk in black shales and slates in the lower rocks, far below the coal measures, where a pit might be sunk to the centre of the earth without ever meeting with coal. Nor are these fruitless enterprises things of the past. They are still going on, in spite of the silent warnings of the fossils in the rocks around, and in spite of the loudly-expressed warnings of the geologists who understand them, but who are supposed still to be vain theorists, and not to know so much as the 'practical man.' Within my own experience large sums of money have been absolutely thrown away which would have been saved by the slightest acquaintance with the laws of palæontology."

ENGINEERING GEOLOGY.†

A SMALLER, but not less valuable, work by the same author. A knowledge of engineering is incomplete without an acquaintance with geology, and in turn geology has been much advanced by engineering operations. This book deals in an admirably clear and succinct manner with the relation of geological strata to practical engineering works; the proper methods of procedure in field work; the economic products of tertiary, secondary, and Palæozoic rocks; springs and water supply; and the selection of building sites. It is a thoroughly useful treatise.

* "A Textbook of Field Geology." By W. H. Penning, F.G.S. With a section on "Palæontology," by A. J. Jukes-Browne, F.G.S. Second edition. (London: Baillière, Tindall, & Cox.)

† "Engineering Geology." By W. H. Penning, F.G.S., Geologist, Government Survey of England and Wales. (London: Baillière, Tindall, & Cox.)

WHERE TO FIND FERNS.*

THIS little book, meant for the pocket, will be found an invaluable companion by all lovers of ferns. The hunting of ferns, as the author remarks, is one of the most delightful of pastimes. It also adds a charm to open-air life, which makes it a very valuable aid to the health and strength. "The seeker after ferns," as Mr. Heath says, "must ride his hobby into the wildest and most out-of-the-way districts, and into the most delicious nooks of greenery—must climb hills, wind through valleys, plunge into woods, follow the course of streams; search rocks, hedge-banks, and forest clumps; examine old walls and tree-forks, and look everywhere, in short, where green life has a chance of existence." Those who know Mr. Heath's "Fern World," and "Fern Paradise," will not need to be told that in such wanderings the student of ferns will find Mr. Heath's pocket companion a most trustworthy guide. Every species of British fern is dealt with in its pages, its peculiarities described, the general nature of its habitat noted, and the places mentioned where it can be found, in England, Scotland, and Ireland. A special chapter on the ferns round London, and an index of localities, add much to the value of the work.

GUIDANCE FOR YOUTHS.†

THIS is a thoroughly practical common-sense guide, a little in advance, perhaps, of the age in teaching emphatically the dignity of honest work, but all the better worth studying, not only by the young, but by those who have charge of the young. Early in its pages it shows the value of artisanship. It is hardly too much to say that every man who values his independence should learn a trade, though it will be long before every man thinks so. "Experientia" tells the story of the clerk who, being in the employ of the wealthy Stephen Girard, was advised to learn the cooper's trade; having learned it, he made for his old master a splendid barrel, for which Girard gave him two thousand dollars, saying, "Now, sir, I want you in my counting-house; but henceforth you will not be dependent upon the whim of Stephen Girard. Let what will come, you have a good trade always in reserve." Years ago—but in such matters they are a century ahead of us in America—Horace Greely wrote:—"It is a source of consolation to us" [he was speaking editorially] "that when the public shall be tired of us as an editor, we can make a satisfactory livelihood at setting type or farming; so that while our strength lasts, ten thousand blockheads, taking offence at some article they do not understand, could not drive us into the poorhouse." But snobs think meanly of independence of that honest sort.

In dealing with moral duties, "Experientia" takes a manly, sensible view (it is not the author's fault nor ours that "Experientia" is feminine). He teaches honesty because it is right, not on the low ground that it is the best policy—though he fails not to show that it is so. He gives wise advice about temperance, treating, smoking, feeding, and so forth. (He goes rather farther, by the way, in saying that man *is* his food, his moral and animal character being constituted by his food, than facts warrant.)

The soundest advice is given when the youth is advised to give his employer no half-hearted work. "Good measure,

* "Where to Find Ferns, with a Special Chapter on the Ferns Round London." By Francis Heath, "Editor of Forestry," &c. New and Cheaper Edition. (Sampson Low, Marston & Co., London.)

† "The Youth's Business Guide. A Practical Manual for Those Entering Life." By Experientia. (London: Wyman & Sons.)

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pressed down and running over"—that is the secret of success in life. Give more than you are strictly bound to give—the extra work is all gain to you, and the profit to the employer is no loss to you. There is sound sense in the old proverb, "Cast your bread on the waters, and you will find it after many days"—though it *does* suggest rather odd ideas among the people of old times as to the way they liked their bread.

Here and there our author does not quite correctly choose his words. A "deferential" bearing is recommended when we fancy the author means a polite and attentive bearing; for he is speaking not of those who, because of age and experience, expect deference, but of those who may have no such special claims. In like manner he says: "We are all responsible to our parents for the training they have given us," where he means that we are responsible to them in such and such ways because of that training. But these are trifling faults; the intrinsic merits of this most useful and suggestive little book are in no way affected by slight flaws such as these.

THE NATURAL IN THE SPIRITUAL.*

Mr. Drummond notes that no class of work is received with more suspicion, almost derision, than those which deal with science and religion, and he shows cause why. But he expresses a hope that though no initial protest will probably save his book from the unhappy reputation of its class, the thoughtful mind will perceive that the fact of its subject-matter being law—a property peculiar neither to science nor to religion—at once places it on a somewhat different footing. That this hope is justified we hardly think. Mr. Drummond, after a very long and rather dreary introduction, dealing with the application of law in the spiritual world, considers:—First, biogenesis in science, and shows, or seeks to show, that biogenesis—the theory *omne vivum ex ovo*—is true in the spiritual world; secondly, the law of degeneration in nature, which he finds in spiritual matters also; thirdly, the law of growth as illustrated by the lilies of the field and the growth of grace; the law of death shows spiritually in this that "to be carnally minded is death"; then, natural mortification, eternal life in nature, environment, conformity to type, parasitism, and so forth, of all which he finds the analogues in the spiritual life also. He does all this cleverly and earnestly, and by those who like such things the book will be found interesting enough. We cannot say that it will appeal very effectively to those who entertain the prejudice mentioned above.

PARADOXICAL PHILOSOPHY.†

It is a melancholy task to deal with such works as this. Here is a volume of some 500 pages, well bound, and well illustrated, presenting the wrong ideas of one who firmly believes Newton to have been little better than a blunderer. It is all hopelessly wrong, of course. But what is one to do? It is painful to tell a man that for nearly a score of years he has been blundering about matters far beyond his powers. Yet it is the sad truth.

Mr. Jordan's fundamental error, on which—as usual with paradoxists—a whole superstructure of erroneous theorising is established, lies in his fancy that *Vis inertiæ* can undergo diminution through the action of forces which in no way affect it—as, for instance, that the horizontal velocity of moving matter is diminished by the vertical action of gravity. He imagines Messrs. Huxley, Carpenter, Spottiswoode, and others, to be opponents of his view, or to be adopting them without acknowledgment, according as he misunderstands them in one way or in another. If any one says that when water leaves a tap horizontally, the horizontal velocity of the water would be unchanged were the air removed, he shows "pronounced hostility to the new discoveries" (these blunders are always "discoveries"); but should the same writer say "if air and gravitation were alike abolished the water would travel horizontally for ever," he is adopting Mr. Jordan's discoveries without acknowledgment.

Mr. Jordan's book reveals no new principles of philosophy, but shows only how its author has misapprehended the established ones. It is a mere collection of blunders, itself a bigger blunder than them all.

* "Natural Law in the Spiritual World." By Henry Drummond, F.R.S.E., F.G.S. (London: Hodder & Stoughton).

† "The New Principles of Natural Philosophy." By William Leighton Jordan, F.R.G.S. (London: David Bogue. 1883.)

THE FACE OF THE SKY.

From May 25 to June 8.

By F.R.A.S.

The sun will be daily examined as usual. The aspect of the night sky will be found delineated in Map VI. of "The Stars in their Seasons." Venus is a morning star, but very badly placed, and Mercury is approaching too close to the sun to be visible. The rest of the planets are invisible too; in fact, it rarely happens that so barren a sky, in this sense, falls to the observer's lot. The Moon is 18·6 days old at noon to-day (the 25th), and 3·2 days old on June 8. She will be new at 12·5 minutes past 6 a.m., on June 5. It will be hence seen that she will be but poorly placed for the observer during the greater part of the period of which we are treating. One occultation of a star will occur at a convenient hour during our prescribed interval. It is that of the 5½ magnitude one, 68 Geminorum, which will disappear at the moon's dark limb at 9 h. 18 m. p.m., on June 7, at an angle of 102° from her vertex, and re-appear at her bright limb at 10 h. 7 m.—at which time, however, she will have set. The moon is in Sagittarius to-day and to-morrow (26th), and crosses Capricornus, during the morning of the 27th, into Aquarius. In this constellation she remains during the 28th and part of the 29th, when she travels into Pisces. She continues in Pisces during the 30th, 31st, and part of June 1, when she passes into Aries. There she remains during the whole of the 2nd, and on the 3rd reaches Taurus. She continues in Taurus during the 4th, and during the 5th too, crossing, however, the northern part of Orion on that day. She is in Gemini on June 6, and travels into Cancer on the 7th, where we leave her on the 8th.

From the *Scientific American* (New York, April 28) it appears that great results are expected from the development of the Deer Creek Coalfields, in Arizona. Although discovered in 1881, active operations only commenced last March. Fifty seams have been opened, seven shafts have been sunk in different places, showing seams varying from 6 ft. to 25 ft.

The Radiation of Silver in Solidifying.—At the International Congress of Electricians in 1881, M. J. Violle proposed, and M. Dumas, the famous chemist, seconded, the use of an absolute unit of light consisting of the radiation emitted by a square centimètre of platinum in melting. At the instance of M. Cochery, the French Minister of Posts and Telegraphs, an investigation of the subject has been begun by M. Violle, and his first experiments have led him to some observations on the radiation of silver in solidifying. A bath of pure melted silver was placed under a thermo-electric pile connected with a mirror galvanometer. The radiation from the bath fell normally on the battery through an aperture in a double-walled screen kept cool by circulating water. As the bath cooled, the pile showed that the radiation slowly decreased until the instant just before solidifying, when there was a slight increase, preceding the final decrease after solidification.

Editorial Gossip.

I AM a lover of chess, but I must confess I find the International Chess Tournament a melancholy sight. To see fourteen men, most of whom have obviously good brains, looking hour after hour at the checquered board—waiting sometimes many minutes, and occasionally a full hour, to decide whether to move this piece or that pawn—is depressing, to say the least. The results may be very fine games. But even to a Steinitz or a Zukertort one of these masterpieces requires many hours' study for its full appreciation; and the amateur, even though a strong one, who sits down to play one of these games, under the impression that he can understand its beauty in less time than two "past masters" in chess took to play it, is grievously mistaken. Our Whist Column yields for awhile to these chess masterpieces and their skilful analysis by the deep Mephisto; but only the most ardent lover of chess can get real pleasure from the study of games so profoundly studied by the players themselves.

I LIKE to flatter myself I am a chess-player of strength. It is a pleasing delusion easily knocked on the head. I give a weakling a queen, and amaze myself by the cleverness of the combinations by which I defeat him; but nine out of ten of them are unsound. I play with the same weakling, even, and am amazed at the stupidity of the blunders by which I bring awful odds against me, and perhaps get beaten. It is a pleasing lesson, again, to sit down to chess with one whom you expect to beat easily, and to find your dashing play met by a quiet but effective resistance. Chess is a game which men play, I think, very unevenly, unless they become professionals, when you can generally tell pretty well what their strength is. At least, it is so with me. Most amateurs take some warming-up to play respectably, and slight distractions will make a knight's difference in their strength. I fancy the professional's strength does not vary this way.

THIS brings luck into the game not a little. I have had good luck in the few games I have played with known chess-players. I played two games (only), and won them both, with Goldsmith, who for two years was the champion player at Melbourne, at a time when Wisker (who had divided with Bird the championship of England) scarcely held his own against Australian players. But I expect that in a set match I would have had as much chance against Goldsmith or Wisker as I should now have against a Steinitz or a Zukertort.

THE question which suggests itself, when one is looking on at a chess tournament between professionals, is, Can chess be regarded as worth studying till a man plays his best possible game? But then the same question applies to all games of skill. Who can do his best at cricket, rowing, whist, draughts, billiards, or any other game without sacrificing much more time and energy to it than a man with brains can reasonably spare from the work of life?

THE moral seems to be not only that such games should be used for relaxation only, but that men of sense should earnestly study to keep such games in their true position. When a man gives more time to them than they deserve, he either shows weakness or fitness for nothing worthier.

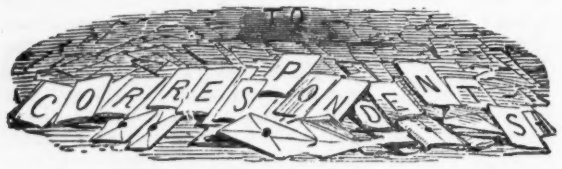
AN incredible thing! Application is made to me to subscribe for cuttings from all the newspapers and periodicals, "at the rate of 5s. for twenty notices, payable in advance, 3d. each notice!" Imagine *paying* to get these things sent to one, as if they did not stream in, "free, gratis, for nothing," till one is disposed to charter a special dust-cart for their removal. I have no reason to complain. The anonymuncules of the press have treated me very kindly—only one in ten or twelve, perhaps, making a mild attempt at a sting. But does any one in his senses want to collect such things? It seems some folks do. The London Society for the Abolition of Compulsory Vaccination subscribes; so does the Editor of the *World;* the Marchioness of Lorne receives cuttings; and so does the Salvation Army. There are many other "clients who continue to patronise the 'Artistic and Literary Correspondence.'" But to most of us cuttings, whether cutting or otherwise, are things to be avoided. One's publishers send enough of them; or extract from a few the few lines of vague praise which are wanted for advertising purposes. But I never came across any of the "2,000 among the first in the artistic and literary world" who are stated to be among the clients of the Artistic and Literary Correspondence. I should picture a client of this sort somewhat as John Leech pictured the person who rejoiced in hearing organ-grinders,—as a harmless but hopeless imbecile. Perhaps the 2,000 have already retired for the most part to their natural home in the neighbourhood of Earlswood.

WHEN I was but a very young beginner in literary work, books used to be sent to me for review. I learned then something of the generosity with which such work is rewarded—the reason why it is done so well. I remember a wealthy Scottish publisher, who had recently started a weekly journal of science, sending me a thick octavo volume of about 500 pages for review—"about a quarter of a column, and the book to be returned." In other words, I was to examine and honestly criticise in a quarter of a column, for 2s. 6d. (or, to be more precise, 2s. 7½d.), a book of that size, and to return the book. Why, the mere time occupied in untying and retying the book in brown paper, and writing the generous publisher's name and address, would have been ill-paid at the price.

CHARLES READE is awfully hard on the criticasters and anonymuncules of the Press,—but he should put some of the blame on those who employ them and practically compel them to be dishonest or to drop the work. The noble critic who said in the *Globe* that "Griffith Gaunt" was stated to be an immoral work, but "on this point, having vainly attempted to read it, he offered no opinion," may not have been so bad as he seemed. True, the book is one which a man vainly attempts *not* to read, when he has once begun it. (I remember how grievously "Griffith Gaunt" wronged me, when years ago I first read it; I thought I had occupation for my leisure hours during three or four days at least; but, Blame the book—to use a favourite oath of an old schoolmaster of mine—it left me no leisure till I had read to the last page, in a third of the time.) And the book encourages immorality about as much as "Macbeth" encourages murder. But if a man, with perhaps a family, has to review a book in the twentieth part of a column, for twopence halfpenny a line, might he *not* vainly attempt to read it? That critic was, perhaps, a poor but honest fellow, misunderstood by the great novelist.

The "Artistic and Literary Correspondence" makes me a present of one notice (price 3d. according to tariff) of my little book, "Mysteries of Time and Space," from the *Glasgow Herald*, in such villainous English that even its

granting freely at the outset that I am "a pleasant and, even to a considerable degree, a profitable figure in contemporary life" (imagine a man being a pleasant and profitable figure!), cannot inveigle me into a verbatim reading. Yet, unless I mistake, I have reason for knowing that, when decently paid, the writer of this rubbish can do much better.



"Let Knowledge grow from more to more."—Alfred Tennyson.

Letters to the Editor.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office, 74, Great Queen-street, W.C.* If this is not attended to, delays arise for which the Editor is not responsible.

All Remittances, Cheques, and Post Office Orders should be made payable to Messrs. Wyman & Sons.

The Editor is not responsible for the opinions of correspondents.

No communications are answered by post, even though stamped and directed envelope be enclosed.

TO DESTROY APHIDES.

[825]—The following will relieve your roses of aphides:—On quassia chips pour boiling water. When cold, strain, and mix with solution of soft-soap; use cold. They are obtained from a large forest tree of Jamaica, and other West Indian islands. Its pure, bitter principles depend on the presence of a crystalline quality, called quassite, or quassine. It is employed as a tonic and febrifuge. A solution acts as a narcotic poison on flies and other insects, and can be employed as an anthelmintic. Law stopped its being used as a substitute for hops. The tree is Quassia (*Picræna excelsa*), and attains a height of nearly 100 feet; and is named after a negro (Quassy), who first discovered its virtues.

John Alex. Ollard, F.R.M.S.

SIWALIK HILLS.

[826]—The correspondent who seeks information regarding the tertiary deposits of the Siwalik Hills, in India, will find what he requires in Medlicott and Blandford's "Geology of India."

C. Carus-Wilson.

FLIGHT OF VERTICAL MISSILE.

[827]—A correspondent in Adelaide asks this question:—If a perfectly spherical ball be shot vertically upwards from the earth's equator, and in vacuo, will it fall to the eastward or westward of the point of projection? Thus, if we take the upward velocity at 1,000 ft. per second, and knowing the equatorial velocity of the earth—required, the precise amount of deviation, if any.

W. P. L.

[Three replies were obtained by W. P. L. and his friends—to wit, that there would be a westerly deviation of 0·25 ft., 71 ft. (!), 282 ft. (!!). I leave the problem as an exercise to readers, but it is hardly necessary to say the two larger deviations are quite wrong.—R. P.]

EDISON ELECTRIC LIGHT COMPANY.

[828]—It is a truism that error dies hard. The paragraph on page 230 of your issue of this date, relative to the cost of the Edison installation at the House of Commons, is an example in point. The *Daily News*, I believe, originally promulgated this, and it has since gone the round of the weeklies. As you may have observed, from the answer of the First Commissioner of Works to a question by Lord Randolph Churchill in the House lately, the contract with the Edison Company was for the lighting of the library and dining-rooms during the current session at a rate somewhat exceeding the cost of gas, or rather over £100. As regards the alleged cost of making the installation, while I do not write officially, I may say that the sum named—£2,000—is much in excess of the actual amount expended.

Correspondent.

A DISCOUNT DODGE.

[829]—"G. M.," in letter 812, page 269, falls into an error regarding easy method of calculating discounts. I found the method in an old arithmetic, and have used it for many years. This is the rule as given in the arithmetic I refer to:—Multiply the principal by double the rate of discount. With the product cut off the last figure to the right in the pounds, the figures to the left will then represent shillings, and the figure to the right will represent pence and the fifths of a penny. Take 3½ per cent. discount on the sum of £187. 10s.

By the ordinary method.	"G. M.'s" method.	Old arithmetic.
£. s. d.	£. s. d.	£. s. d.
187 10 0	187 10 0	187 10 0
3½	7	7
93 15 0	131,2 10 0	131,2 10 0
562 10 0	12	+⅕0 10 0
6,56 5 0	3,4 = £6 11 3 and fraction.	3 0 0 = £6 11 3
20		
11,25		
12		
3,00 = £6 11 3		

The last method will be found to work true, no matter what parts of a pound there may be in the principal. For instance,—£123. 4s. 1d. at 5¼ per cent., say £123. 4s. 1d. × 11 = £135,5. 4s. 11d.

a fifth added	1	0 11¼
	6	5 10¼

= £6. 15s. $6\frac{59}{200}$d.

T. J. K.

[Readers will find it a pleasant study to note how this result comes about—R. P.]

EASY MULTIPLYING.

[830]—I beg to call your attention to another easy multiplication. About eight years ago, an American doctor taught me a simple method to get square powers of these nine numbers, viz., 15, 25, 35, 45, 55, 65, 75, 85, and 95. Rule.—Prefix the product of the left-hand figure, multiplied by another higher by one than itself, to the square of the 5.

Examples:—

35 × 35	3 × 4 = 12	65 × 65	6 × 7 = 42
	5 × 5 = 25		5 × 5 = 25
	1225		4225

The following is a method found out by myself. By this I can multiply any two numbers under 100, providing that either left or right-hand figures are alike. For instance:

24 × 34 = (20 × 30)	= 600
(20 + 30) 4	= 200
4 × 4	= 16
	816

61 × 67 = 60 × 60	= 3600
(1 + 7) 60	= 480
1 × 7	= 7
	4087

This method is not unlike that of Mr. J. Smith, but, I think, a little easier. If I write down both multiplicand and multiplier, thus:

$\frac{51}{58}$ result of which will be so, $\frac{51}{58}$ in a moment.

$\overline{2958}$

R. Kawada.

EXTRACTING SQUARE ROOT.

[831]—Perhaps the following mode of extracting square roots may interest some of the readers of Knowledge. I can't say much for its practical utility, but I have now and then found it handy when I have not had a logarithm book available. It, of course,

follows from the law that the squares are proportional to the odd numbers.

Let it be required to extract the square root of any number—say, 9604. Square a number that is somewhere near it—say, 90. This gives 8100. Then square the next higher number, 91. We obtain 8281; difference by subtraction, 181.

Now subtract in turn all the odd numbers from 181 upwards from our original square 9604, till we obtain a remainder of 8100, and (90 + number of subtractions) will be the root required. If the square be not a perfect one, we, of course, only obtain the nearest whole number by subtracting till the remainder is nearest to that we require.

WORKING OF PROBLEM.

$90^2 = 8100$, $91^2 = 8281$, $8281 - 8100 = 181$

$9604 - (181 + 183 + 185 + 187 + 189 + 191 + 193 + 195) = 8100$

$\therefore$ sq root of $9604 = 90 + 8 = 98$.

T. R. B., Lieut. R.A., F.R.A.S.

MUSICAL QUESTION, 808.

[832]—Mr. Walter Jones and his musical friends fall into the common error of confounding musical instruments with music. There is no difference in the same chord if struck in two different keys, C major or C sharp major—naturally. There are but two classes of instruments in this world that give out true music, and they are the vocal organs of men, women, and children, and the fiddle family. The over-lauded organ and the modern pianoforte have much to answer for in destroying our natural ear for music. In my boyhood I used to run after a man who played the triangles with his feet, the cymbals with his knees, the big drum with his elbows, the accordion with his hands, the pandean pipes with his mouth, and a bunch of bells with his head—six instruments at once, no doubt all out of tune. Not so bad. But pretty much the same is the pianoforte, which endeavours, by the touch of *one* performer, to represent the effect of an orchestra, and, by an arrangement of black and white keys, to produce all the chords and modulations of nature.

Music consists simply of eight sounds, the first and last being alike, separated by seven intervals—three great tones, two small tones, and two so-called semitones.

Expressed in figures, the difference between any sound and its octave may be represented by 474.

From 1 to 2	80	degrees
2 to 3	72	,,
3 to 4	45	,,
4 to 5	80	,,
5 to 6	72	,,
6 to 7	80	,,
7 to 8	45	,,
	474	

With the voice or violin, where there are no key-boards and fixed sounds to bother you, it is quite possible, when the brain and stomach are in fair working order, to sing or play any passage in tune. But, with the pianoforte tuned (or, one might say, mistuned) to equal temperament, it is impossible for Mr. Walter Jones to play *any* chord in tune, no matter whether he commences on C or C sharp.

In equal temperament, the scale is divided into twelve equal semitones; that is to say, five whole tones, all alike, and two semitones, thus:—

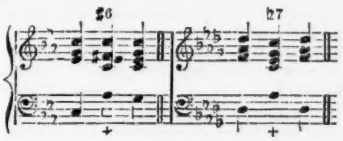
	Equal Temperament.		Natural.
From 1 to 2	79	instead of	80
2 to 3	79	,,	72
3 to 4	39½	,,	45
4 to 5	79	,,	80
5 to 6	79	,,	72
6 to 7	79	,,	80
7 to 8	39½	,,	45
	474		474

To place the matter before you at a glance, I send you enclosed a long piece of paper showing two octaves of natural sounds side by side with two octaves of equal tempered pianoforte sounds, and a short piece of paper with one octave of nature's sounds drawn to the same scale.

If you use the small piece as a sliding scale by laying it on the larger, you will see at a glance where the sounds don't fit. This will perhaps explain why the verse parts of a cathedral anthem sound like heavenly music when unaccompanied by the organ, why "Cast thy burden upon the Lord," in "Elijah," when sung by such artists as Titiens, Dolby, Reeves, and Santley, causes a feeling of satisfaction vastly different to that of, say a German band, or an average congregation when each one fills up the intervals in the scale according to his temperament.

Why Mr. Jones finds the common chord of C more grateful to his ear than that of C sharp, is because the tuner has shown his judgment in throwing the necessary errors into those keys where they are less likely to be discovered. J. H. CHATTERTON.

[833]—Your correspondent Walter Jones (808) may be more surprised to learn that no two keys on the piano have the same sound. Each has its own distinct individuality, and arises from the fact of the great difference between the enharmonic notes—*i.e.* G sharp is not A flat, F sharp is not G flat, &c.; but on the piano each black key has to serve the double purpose, therefore is tempered, or tuned in between, which makes the intervals, thirds and fifths of each key all different in distance. This is so equally dispersed by good tuners as to be almost imperceptible, but is quite sufficient to account for the fact.

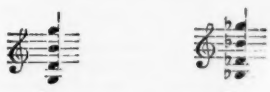
While on the subject, may I point out another curious fact. The notes of the chords of the sharp sixth and flat seventh on the piano are identical, and yet have a different sound. The following is an illustration:—

The chords above the cross are the same on the piano, and yet produce a totally different effect. The reasons are they both occur in different progressions and have both different resolutions.

WILLIAM GODDEN, Professor of Harmony.

[834]—This question has been considered a good many times, even amongst musicians, and it has been asked, consequently, Why do composers often write their pieces in such a lot of flats or sharps, when the more simple keys would answer the same purpose, and make a piece of music so much less difficult for the general public?" Now, I am of opinion that, speaking of the pianoforte, the chord of C sharp, or a piece written in that key, would produce exactly the same effect upon an audience as if played in C natural, because in our modern system of keys the relations of one key are the same as those of another.

Supposing you had two pianofortes, the second tuned a semitone higher than the first, then C natural on the one would sound C sharp on the other, and a piece in C played on the first, C sharp on the second, and *vice versâ*.

But as soon as the orchestra is concerned, matters alter altogether, where there are combinations of a very different character to those on the piano. On a stringed instrument, for instance, the chord (1) would, on account of the empty strings and their harmonies, give a very different effect—or Klang-tint, as Helmholtz calls it—to chord 2, where every string



is covered by the fingers and the vibrations interrupted. Here the tone not only alters as to pitch, but also as to intensity and quality. Hector Berlioz has, in his celebrated "Instrumentations-lehre," assigned special and individual characters to each major and minor key; but, in a great measure, this will be more or less a matter of subjective feeling—on the piano, absolutely imaginary.

A nocturne of Chopin, written in D flat and played in D natural, loses certainly all poetical expression for the performer; but for an audience unaware of the transposal, I dare say none—or very few, perhaps—would be cognisant of the fact. This would simply prove what you wish to know, viz., that there is in reality no difference between the chord of C and C sharp on the pianoforte, except, of course, that of pitch. GUSTAVE WOLFF.

THE DIVIDED SKIRT.

[835]—As the divided skirt was brought out by the Rational Dress Society, will you allow me to say that it is meant to be worn as the dress itself, and not merely as an under petticoat? Wearing

it in this last manner defeats its principal objects, which are cleanliness in walking and absence of drag and twisting round the ankles. It should be at least four inches longer than the light overskirt or drapery. I have worn it this way for the last two years, and it does not look remarkable in any way.

A small sketch of three figures in the dress can be obtained by sending a stamped and directed envelope to the Secretary of the R. D. S., asking for a circular of the Society's rules, &c. Her address is Miss E. M. Carpenter, 69, Shaftesbury-road, Hammersmith, W. A Member of the R. D. S.

["A Lady" refrained from advising a change which seemed hopeless to advocate, as nine ladies out of ten (herself included) would be unwilling to wear such a dress. But she states, from her own experience, that wearing a dress such as she described secures all the advantages of the divided skirt, and does not in any perceptible degree defeat its purpose.—R. P.]

HEATING POWER OF STEAM.

[836]—Having met the paragraph at foot in "Lectures on Arts connected with Organic Chemistry," by W. T. Brande (p. 213), at the Royal Institution, 1852 (Longmans), and being at a loss for the reason of the apparent contradiction, I should be glad if you will kindly explain it. I may add that the statement occurs in the lecture on Sugar Refining, in connection with remarks on working the vacuum-pan; but it is general in its application, and being published by a man in Mr. Brande's position, evidently cannot but be well considered. Bristol Boiler-Maker.

"In stating that high-pressure steam has not so great a heating-power as steam under 10 lb. to the square inch, the remark must be limited to the condition of heating a fluid by means of a steam-warmed jacket or coil. If a fluid be heated by injecting steam into and through it, then high-pressure steam, weight for weight, is the more powerful."

LETTERS RECEIVED AND SHORT ANSWERS.

T. C. Really, does it matter how those particular names are spelled. I thought all that nonsense had died out, except, of course, among the majority, who ever have been, and ever will be, behind the age.—E. Hull names Medlicot and Blanford's "Manual of the Geology of India" as a book giving valuable information about Savalik Hills.—A Spelling Reformer. Can scarcely give so much space to the subject as your letter would require. It is a barren subject, anyway; for no good will ever come of showing how much good *would* come from reform.—Phonus. Same reason applies.—H. W. B. B. We have wider ideas of the domain of science. In what you think remote from science may be discerned very interesting evidence of the inherent savagery of man.—Parpropari. Ah, well! we differ then. If you were as indifferent to converting me as I am to converting you, you would hardly have written your letter. What can it matter, anyway?—A. McD. Thanks for your genial letter. Such a letter is as cheering as a glass of wine (*pace* Sir W. L.!) They *are* a "cantankerous lot," and the fable of the old man, his son, the ass, and the other asses, *does* often occur to me.—Thos. Little. Lectures not published, possibly because not yet committed to paper.—E. C. Werner. Mr. L.'s letter removes all doubt on that point; he disclaims all knowledge about the matter.—Ignoramus. Hope soon to make room for translation of original dream.—Magister. Glad the "First Book of Knowledge" pleased you as well as it did me. Cannot, unfortunately, speak of other books of the kind.—J. R. (Edinburgh). The book is useful, though, as you say, cumbrous and ill-written; I do not think more was claimed for it in review than it deserved. It is evidently the result of much hard work.

Our Mathematical Column.

PROBLEM.—To find a root other than unity of the equation $x^{17}=1$.

$$x^{17}=1 \qquad (1)$$

$$\therefore\ x^{17}-1=(x^{16}+x^{15}+\ \dots\ +x+1)\,(x-1)=0$$

Hence we have by a due arrangement of terms

$$1+x+x^{16}+x^2+x^{15}+\ \dots\ +x^8+x^9=0$$

or

$$1+x+\frac{1}{x}+x^2+\frac{1}{x^2}+\ \dots\ +x^8+\frac{1}{x^8}=0 \qquad (2)$$

Let

$$y=x+\frac{1}{x}+x^2+\frac{1}{x^2}+x^4+\frac{1}{x^4}+x^8+\frac{1}{x^8}$$

$$\therefore\quad y+1=-\left(x^3+\frac{1}{x^3}+x^5+\frac{1}{x^5}+x^6+\frac{1}{x^6}+x^7+\frac{1}{x^7}\right)$$

Hence, by multiplication [remembering that $x^{17}=1$]:—

$$\begin{aligned}-y\,(y+1)=&\,x^4+\frac{1}{x^4}+x^7+\frac{1}{x^7}+x^8+\frac{1}{x^8}+x^4+\frac{1}{x^4}+x^7+\frac{1}{x^7}+x^5+\frac{1}{x^5}\\&+x^3+\frac{1}{x^3}+x^8+\frac{1}{x^8}+x^6+\frac{1}{x^6}+x^5+\frac{1}{x^5}+x+\frac{1}{x}+x^7+\frac{1}{x^7}+x^3+\frac{1}{x^3}\\&+x^9+\frac{1}{x^9}+x^4+\frac{1}{x^4}+x^6+\frac{1}{x^6}+x^5+\frac{1}{x^5}+x^7+\frac{1}{x^7}+x+\frac{1}{x}\\&+x^9+\frac{1}{x^9}+x+\frac{1}{x}+x^7+\frac{1}{x^7}+x^2+\frac{1}{x^2}+x^6+\frac{1}{x^6}+x^3+\frac{1}{x^3}\\&+x^6+\frac{1}{x^6}+x^5+\frac{1}{x^5}+x^4+\frac{1}{x^4}+x^3+\frac{1}{x^3}+x^3+\frac{1}{x^3}+x^2+\frac{1}{x^2}\\&+x^2+\frac{1}{x^2}+x+\frac{1}{x}=-4\end{aligned}$$

$$\therefore\quad y^2+y+\frac{1}{4}=4+\frac{1}{4}=\frac{17}{4}$$

$$\therefore\quad y=\frac{\pm\sqrt{17}-1}{2} \qquad (3)$$

Selecting the upper sign, we have

$$x+\frac{1}{x}+x^2+\frac{1}{x^2}+x^4+\frac{1}{x^4}+x^8+\frac{1}{x^8}=\frac{\sqrt{17}-1}{2} \qquad (4)$$

And hence

$$x^3+\frac{1}{x^3}+x^5+\frac{1}{x^5}+x^6+\frac{1}{x^6}+x^7+\frac{1}{x^7}=\frac{-\sqrt{17}-1}{2} \qquad (5)$$

Let

$$z=x+\frac{1}{x}+x^4+\frac{1}{x^4}$$

Hence from (4)

$$\frac{\sqrt{17}-1}{2}-z=x^2+\frac{1}{x^2}+x^8+\frac{1}{x^8}$$

$$\therefore\quad \left(\frac{\sqrt{17}+1}{2}-z\right)z=x^3+\frac{1}{x^3}+x+\frac{1}{x}+x^5+\frac{1}{x^5}+x^7+\frac{1}{x^7}+x^6+\frac{1}{x^6}+x^2+\frac{1}{x^2}+x^5+\frac{1}{x^5}+x^4+\frac{1}{x^4}=-1$$

$$\because\quad z^2-\frac{\sqrt{17}-1}{2}z+\frac{(\sqrt{17}-1)^2}{16}=\frac{16+(\sqrt{17}-1)^2}{16}=\frac{2(17-\sqrt{17})}{16}$$

$$\therefore\quad z=\frac{1}{4}\left(\sqrt{17}-1\pm\sqrt{2}\sqrt{17-\sqrt{17}}\right) \qquad (6)$$

Selecting the upper sign, we have

$$x+\frac{1}{x}+x^4\frac{1}{x^4}=\frac{1}{4}\left(\sqrt{17}-1+\sqrt{2}\sqrt{17-\sqrt{17}}\right) \qquad (7)$$

Let $u=x^3+\frac{1}{x^3}+x^5+\frac{1}{x^5}$

Hence from (5)

$$\frac{-\sqrt{17}-1}{2}-u=x^6+\frac{1}{x^6}+x^7+\frac{1}{x^7}$$

And by multiplication as before we have

$$\left(\frac{-\sqrt{17}-1}{2}-u\right)u=-1$$

$$\therefore\quad u^2+\frac{\sqrt{17}+1}{2}+\frac{(\sqrt{17}+1)^2}{16}=\frac{(\sqrt{17}+1)^2+16}{16}=\frac{2(17+\sqrt{17})}{16}$$

$$\therefore\quad u=\frac{1}{4}\left(-\sqrt{17}-1\pm\sqrt{2}\sqrt{17+\sqrt{17}}\right) \qquad (8)$$

Selecting the upper sign, we have

$$x^3+\frac{1}{x^3}+x^5+\frac{1}{x^5}=\frac{1}{4}\left(-\sqrt{17}-1+\sqrt{2}\sqrt{17+\sqrt{17}}\right) \qquad (9)$$

Let

$$v=x+\frac{1}{x}$$

Hence, by (7)

$$\left[\frac{1}{4}\left(\sqrt{17}-1+\sqrt{2}\sqrt{17-\sqrt{17}}\right)-v\right]v=\left(x^4+\frac{1}{x^4}\right)\left(x+\frac{1}{x}\right)=x^5+\frac{1}{x^5}+x^3+\frac{1}{x^3}=\frac{1}{4}\left(-\sqrt{17}-1+\sqrt{2}\sqrt{17-\sqrt{17}}\right)\text{ by (9)}$$

Hence, by a little tedious multiplication and addition, we obtain

$$v = \frac{1}{8}\Big[\sqrt{17}-1+\sqrt{2}\sqrt{17-\sqrt{17}}\pm \sqrt{68+12\sqrt{17}+(2\sqrt{2}\sqrt{17-\sqrt{17}})(\sqrt{17}-1)-16\sqrt{2}\sqrt{17+\sqrt{17}}}\Big] \quad (10)$$

We will select the upper sign, for $x+\frac{1}{x}$

But $$x+\frac{1}{x}=v$$

$$\therefore \quad x^2-xv+v^2=v^2-1$$

and $$x=\frac{v}{2}\pm\frac{\sqrt{v^2-1}}{2}$$

selecting the upper sign we have

$x=\frac{v}{2}+\frac{\sqrt{v^2-1}}{2}$ where v is the function on the right hand side of equation (10).

A. M. M.

Our Chess Column.

By MEPHISTO.

THE TOURNAMENT.

SCORE UP TO TUESDAY NIGHT.

	Bird	Blackburne	English	Mackenzie	Mason	Mortimer	Noa	Rosenthal	Sellman	Skipworth	Steinitz	Tschigorin	Winawer	Zukertort	Draws not counting	Total score
Bird	—	1	1	1	0	1	0	0	1	1	0	0	1	0	5	7
Blackburne	0	—	1	0	1	1	1	1	1	1	1	0	½	0	6	8½
English	0	0	—	½		1	1		1	1	1	1	0	0	8	6½
Mackenzie	0	1	½	—	0	1	1		½	1	0	0	0	0	7	5
Mason	1	0		1	—	1	½	1	1	1	0	1	1	0	7	8½
Mortimer	0	0	0	0	0	—	0	0	0	0	0	0	0	0	3	0
Noa	1	0	0	0	½	1	—	1	0	0	0	0		0	5	3½
Rosenthal	1	0			0	1	0	—	0	1	1	1	½	0	10	5½
Sellman	0	0	0	½	0	1	1	1	—	0	0	0	0	0	5	3½
Skipworth	0	0	0	0	0	1	1	0	1	—	0	0	0	0	2	3
Steinitz	1	0	0	1	1	1	1	0	1	1	—	0	1	1	1	9
Tschigorin	1	1	0	1	0	1	1	0	1	1	1	—	1	0	2	9
Winawer	0	½	1	1	0	1		½	1	1	0	0	—	0	9	6
Zukertort	1	1	1	1	1	1	1	1	1	1	0	1	1	—	4	12

The first round of the Tournament is all but finished, and the second round was fixed to begin on Thursday, the 24th inst. The players who had no draws to play off are enjoying a welcome holiday, while both Rosenthal and English will not have finished their games by Thursday, as they still have three draws each to play off. Theirs is by no means one of the best scores, and their position confirms the axiom that players whose play is of an undecisive character, favourable to producing drawn games, will not take high honours in a Tournament.

The following players have still games to play:—Steinitz 1 (against Rosenthal, his only draw as yet), Mason 1, English 3, Winawer 1, Rosenthal 3, Makenzie 2, Noa 1. The quality of play has been highly satisfactory on the whole, although by no means free from accidental results, only less so than in other Tournaments. If we compare the position of some of the players after the conclusion of the first round at this Tournament with the Vienna Tournament of last year, some very remarkable results are obtained. Thus, at Vienna, Mackenzie stood at the head with a score of 12½, which put him above Steinitz, Blackburne, and Zukertort, while here his score is very low, and hardly half that of Zukertort, who, again, stood three below Mackenzie at Vienna.

The lion share of praise belongs to Zukertort. Taking the great excellence of his fellow competitors into consideration, his noble score of 12 out of a possible 13 is the finest score made in any tourney. His play is vivacious and elegant, which is particularly refreshing in contrast to dulness practised in other quarters. His firmness and steadiness is a proof of a sound body, as well as a sound mind. If he keeps in the same good physical condition throughout the next hot month he will carry off the first prize.

Steinitz (9) has sacrificed too much in favour of certain openings, and has, therefore, paid a penalty which will materially injure his chance for first prize. Everything proceeds forward with rapid strides now-a-days, and the player, who through confidence in himself, engendered by former victories, thinks he may do without keeping within the bounds marked out by the latest analysis of the openings, will certainly meet with unexpected reverses.

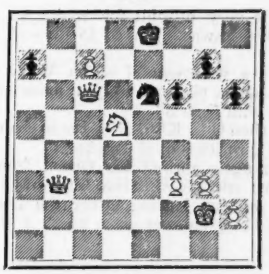
Tcshigorin (9) has not only proved himself a highly original and inventive player, but as being possessed of those staying qualities so valuable towards success in a tourney. He has, indeed, whatever his final position may be, achieved high honours by his fine victories over some of the best men, viz., Steinitz, Winawer, Blackburne, and Mackenzie.

Mason has gone on with his usual steadiness, and although he has not exceeded himself, he is, nevertheless, in the foremost rank, his present score being 8½.

On Tuesday Rosenthal played the two Knights, to which Steinitz replied with 3. P to KKt3, as in his games with Blackburne and Zukertort. The result of this perseverance in the wrong direction was that Steinitz sustained a decisive defeat, placing him at 9 against Zukertort's 12.

POSITION AFTER BLACK'S 46TH MOVE IN THE FINAL GAME BETWEEN ZUKERTORT AND ENGLISH.

ENGLISH.
BLACK.



WHITE.
ZUKERTORT.

Zukertort finished the game in very elegant style by playing—

47. Q to Kt5, Q takes Q (forced)
48. P Queens (ch), K to B2
49. Q takes Kt (ch)! K takes Q
50. Kt to B7 (ch), K to K4
51. Kt takes Q, and White won after 68 moves.

PLAYED IN THE FIRST ROUND ON MAY 18.

White. Winawer.	Black. Blackburne.	White. Winawer.	Black. Blackburne.
1. P to K4	P to K4	21. R takes B	Q to Q3 (*d*)
2. KKt to B3	KKt to B3	22. QR to KB sq	R to K2
3. Kt takes P	P to Q3	23. Q to B2	Kt to K4 (*e*)
4. Kt to KB3	Kt takes P	24. P takes Kt	Q takes B
5. P to Q4	B to K2	25. R to B6 (*f*)	R takes P (*g*)
6. B to Q3	P to Q4	26. R takes BP	Q tks. R (ch)(*h*)
7. Castles (*a*)	Castles	27. Q takes Q	R takes R
8. P to B4	QKt to B3	28. Q to Q3 (*i*)	P to Kt3 (*j*)
9. P takes P (*b*)	Q takes P	29. P to QKt4	KR to K2
10. R to K sq	Kt to B3 (*c*)	30. Q to R6	P to B4
11. Kt to B3	Q to Q sq	31. Q to B8 (ch)	K to Kt2 (*k*)
12. P to KR3	B to K3	32. P takes P	R takes BP
13. B to K3	Kt to Q4	33. Q to Q8	QR to K4
14. Q to B2	P to KKt3	34. Q to Q4	K to B2
15. P to R3	B to B3	35. Q to QB4 (ch)	K to B sq
16. Kt to K4	Kt takes B	36. Q to B3 (*l*)	P to QKt4
17. P takes Kt	B to Q4	37. P to K4	K to B2
18. Kt takes B (ch)	Q takes Kt	38. Q to R5	P to KR4
19. R to KB sq	QR to K sq	39. Q to R6 (*m*)	K to Kt2
20. QR to K sq	B takes Kt		

NOTES.

(*a*) We prefer P to B4 before Castling.
(*b*) Kt to B3 looks a promising move, and would be our choice.
(*c*) The objection to this opening is that this Knight must gene-

rally retire when a position is obtained which can be reached one move earlier by playing the French defence.

(*d*) White's centre Pawns are weak, and the Queen is well posted there to prevent their advance.

(*e*) A very clever device, it leaves White no alternative.

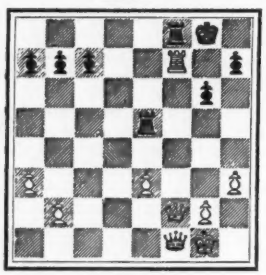
(*f*) With the intention of advancing P to K6 if possible.

(*g*) We would have played Q to Q2, White could not then advance the Pawn which is threatened by the Rook.

(*h*) A bold course, which hardly promises more than a draw. Blackburne truly pointed out that R to B4 would force the exchange of the Queen and two Rooks, and leave Black with a slightly preferable Pawn position.

BLACKBURNE.

BLACK.



WHITE.

WINAWER.

(*i*) The ending is very difficult for White, on account of the weak position of his Pawns. Played to prevent KR to K2 by Q to Kt3 ch.

(*j*) This creates a weakness of which White cleverly avails himself in his subsequent play. P to QR4 looks stronger. White might reply to this with Q to B3.

(*k*) If K to B2, then Q to KR8, after the exchange of Pawns.

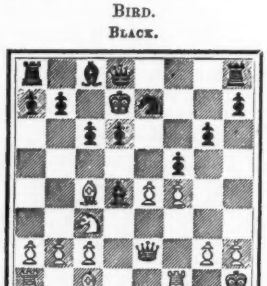
(*l*) Threatening Q to R8 (ch) if R takes P.

(*m*) White never again retired his Queen from that quarter, although Blackburne tried hard to lure him away; and, as neither Rooks could move without leaving either the Rook's or Knight's Pawn unprotected, the game was given up as a draw after about 65 moves.

POSITION AFTER BLACK'S 13TH MOVE.

BIRD.

BLACK.



WHITE.

STEINITZ.

Steinitz played—

White. Steinitz.	Black. Bird.	White. Steinitz.	Black. Bird.
14. R to Q sq	B takes Kt	21. Q takes R	Q takes B
15. P takes B	P takes P	22. R to K sq	Q to Q3
16. B to R 3	P to Q4	23. R to K8	Q to Q2
17. Q takes P	P to QKt4	24. QR to K sq	Q to QB2
18. B takes KtP!	P takes B	25. Q to B6 (ch)	K to B4 (*b*)
19. B takes Kt!	K to B3 (*a*)	26. R(Ksq)toK6(*c*)	B takes R
20. Q to K5	Q to Q2	27. R takes B	resigns.

(*a*) If Q takes B, Black loses the Queen by 20. R takes P (ch), K to K sq. 21. R to K5.

(*b*) If K to Kt2. 26. R to K7, B to Q2. 27. R takes B, Q takes R. 28. R to K7 winning.

(*c*) Threatening an ingenious mate by Q to Q4 (ch), which Black cannot prevent.

GAME BETWEEN BLACKBURNE AND ROSENTHAL.

SCOTCH OPENING.

White. Blackburne.	Black. Rosenthal.	White. Blackburne.	Black. Rosenthal.
1. P to K4	P to K4	13. Q to K2	B to R6
2. Kt to KB3	Kt to QB3	14. Castles (KR)	Castles (KR)
3. P to Q4	P takes P	15. P to KB5	P to KB3
4. Kt takes P	B to QB4	16. QKt to B2	Kt to K4
5. B to K3	Q to B3	17. Kt to Q4	P to KKt4
6. P to QB3	KKt to K2	18. Kt to K6	KR to QB sq
7. Kt to B2 (*a*)	B to Kt3	19. QR to Q sq	P to Kt4
8. QKt to R3	B takes B	20. R to B2	KKt to B3
9. Kt takes B	P to QR3	21. B takes B	Q takes B
10. P to KKt3	P to Q3	22. Kt to Q5 (*c*)	Kt to KKt5
11. B to Kt2	B to K3	23. Q takes Kt and wins (*d*)	
12. P to KB4	Q to R3		

(*a*) Mr. Blackburne's favourite, played by him at Vienna last year.

(*b*) Loss of time, besides posting the Kt well at K3.

(*c*) Giving White a substantial advantage.

(*d*) A fine stroke, which practically decides the game. Black could not retake on account of Kt takes P (ch), winning the Queen. Black struggled on for eight more moves, and then resigned, after 3½ hours' play.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

F. W. R.—In game between Steinitz and Winawer, p. 272, Black's 9th move is B to Q3, instead of K3.

T. T.—See solution of No. 84, p. 256.

L. G. RYLANDS.—The fact of a piece being pinned does not deprive it of its checking powers.

S. L. B.—It is as you say, the combination that was sprung upon "Z" was one move deep. It is a true specimen of play that occasionally occurs at tournaments. A more vexatious thing than that even happened to us. We opened a game as follows:—1. P to K4, P to K4. 2. Kt to QB3, Kt to QB3. 3. B to B4, Kt to B3. 4. Kt to B3, Kt takes P. 5. B takes P (ch), K takes B. 6. Kt takes Kt, P to Q4. 7. KKt to Kt5 (ch), K to Kt3 (?). 8. Q to B3, P takes Kt (?). 9. Q to B7 (ch), K takes Kt, having, partly by our own enterprise, and partly by our opponent's weak play, arrived at this position, which yields some very interesting analysis, in most of which the tenacious Black King comes out victorious. We played P to Q3 (ch), and soon obtained the worse game. But if the same check is given by P to Q4, the game can be forced, *i.e.*—10. P to Q4 (ch), K to R5. 11. P to KR3, P to KKt3 (best). 12. P to Kt3 (ch), K to R4. 13. P to Kt4 (ch), K to R5. 14. Q to QKt3, and wins.

A LEARNER.—1. P to QB4 constitutes the English opening; it is usually followed by P to K3. 2. P to K3, Kt to KB3. 3. P to Q4, P to Q4, &c.

R. HALLIDAY. E. T. RIDSDALE.—In the game of Mackenzie *v.* Bird, p. 302, the diagram is misprinted, but the text is correct.

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